and more water the jelly sets more firmly and cuts more easily, but is less transparent.

I have used such jelly in preparing sections of the wings of insects. The wing was first placed in an ordinary silvering solution containing Rochelle salts to which 50 per cent. of alcohol had been added. After it had thereby become blackened from the deposit of metallic silver it was washed with 50 per cent. alcohol and then placed in rectified spirit. To embed the wing after this treatment I formed a cell of plasticine on a sheet of glass. A layer of melted jelly was placed in the cell, which was then filled up with alcohol. The wing was placed in the cell. It dropped through the alcohol on to the surface of the jelly. The alcohol was at once run off by making a cut through the walls of the cell. The latter was then filled up with more of the jelly. By this procedure wings of moths and butterflies, which are not readily wetted by water, could be obtained firmly embedded, free of air-bubbles and without displacement of the scales. To the 60 c.c. of water used in making the jelly I had added 16 grams of hyposulphite of soda. Having cut the lump of jelly containing the wing into ten slices of equal thickness with a Gillette razor-blade, these slices were threaded in order on a wire, and placed all night in a half-saturated solution of tartaric acid in 70 per cent. glycerine. The acid decomposed the hypo., liberating sulphur, with the result that the jelly acquired an ivory-white colour, on which the wing-sections appeared in black. The slices were mounted in a cell containing glycerine jelly. Embedding in celluloid no doubt would be preferable for wings of smaller insects. The method here described is probably more suitable for larger insects, the wings of which would be likely to offer difficulties in an attempt to cut thin sections.

E. H. HANKIN.

Agra, India.

National Service.

THE wording of the enrolment form for National Service having given many the impression that volunteers are wanted only for industrial work, which some men over fifty cannot possibly undertake, I wrote to the Director of National Service for definite information, and my queries were answered as follows:—

"National volunteers are required not only for industrial work, but also for other positions of national importance."

Further: "Mr. Chamberlain wishes it to be clearly understood that brains as well as 'hands' are required, and also that no volunteer will be set to do work for which he is not fitted personally."

These very clear and authoritative replies will, perhaps, relieve the doubts of many who have been hesitating on the very reasonable ground that the work involved seemed to be beyond their capacity.

C. WELBORNE PIPER.

THE CLASSIFICATION OF HELIUM STARS.

WHILE it is now generally admitted that the spectroscopic differences between the different classes of stars are mainly due to differences of temperature, there are two widely divergent views as to the order of celestial evolution which may be inferred. In one of them, the evolution is supposed to proceed by a continuous decline of temperature from the white to the red stars; in the other, which has been consistently advocated by Sir Norman Lockyer during nearly thirty years, it is maintained that the progression is from stars at a low stage of temperature to the hottest stars, and from these to stars at a low temperature, so that a given star will have the same temperature twice in the course of its evolution. The classifications of Rutherfurd, Secchi, and Vogel, and the expansion of these into the Harvard system, may be interpreted in terms of the first hypothesis, though actually they may be regarded as merely empirical and independent of any such consideration. The classification of Lockyer, on the other hand, is essentially based upon the supposition that there must be stars which are getting hotter as well as stars which are cooling, in accordance with the theory of condensing masses of gas or swarms of meteorites.

If the spectrum of a star depended solely upon the surface temperature, there would evidently be no observational means of distinguishing between the two hypotheses. But Lockyer finds that when stars at any given stage of temperature are brought together by reference to the relative intensities of certain lines, selected according to the indications of laboratory experiments, they are divisible into two distinct groups. The spectra, therefore, seem to depend in part upon physical conditions other than those imposed by temperature alone. The difference is quite probably due to a difference in the degree of condensation, and Lockyer's interpretation assigns one of the groups to the ascending, and the other to the descending, branch of the temperature curve. The Harvard classification takes no account of these differences, and is accordingly along one line of temperature only.

The difference between the opposing views as to the order of celestial evolution is clearly of a very fundamental character, and it is important that the question should be attacked in as many ways as possible. The work of Prof. H. N. Russell (NATURE, vol. xciii., p. 283) on the absolute magnitudes of stars has already given considerable support to the main principle of Lockyer's classification, by especially emphasising the idea that the order of celestial evolution is primarily one of increasing density, with a maximum of temperature near the middle of the sequence. As regards the helium stars, Dr. Ludendorff found in 1912 (NATURE, vol. lxxxviii., p. 424) that the radial velocities showed a very decided systematic difference for the ascending and descending stars classified by Lockyer, a difference which was not so clearly shown when the velocities were referred to the Harvard sub-classes.

Since the publication of Ludendorff's results, Lockyer has supplemented his original catalogue of 470 stars by a second catalogue of 354 stars, and a third catalogue of 287 stars, photographed and classified at the Hill Observatory, Sidmouth (*Hill Obs. Bull.*, Nos. 3 and 5). The first attempt to utilise some of the additional data which have thus become available has been made by Dr. B. P. Herassimovitch in a recent communication to the Petrograd Academy of Sciences (Bull. Acad. Imp. Sci., 1916, p. 1419). In this paper the helium stars included in the first two catalogues of Lockyer are discussed in relation to the radial velocities, so far as they have been determined. For the ascending branch there are 57 such stars in the two catalogues, and for the descending branch 47 stars.

It should perhaps be recalled that the helium stars constitute type B of the Harvard classification, and are subdivided into classes B0 to B9, in accordance with variations in detail. In Lockyer's system, seven classes of helium stars are recognised, three on the ascending branch, one at the apex, and three more on the descending branch of the temperature curve, thus:—

Alnitamian
↑ Crucian Achernian ↓
Taurian Algolian
Rigelian Markabian

It was found by Campbell that after eliminating the apparent velocity due to the sun's motion, the helium stars showed a systematic positive (receding) velocity of +4·07 km., the apex of the sun's way being taken as $\alpha = 270^\circ$, $\delta = +30^\circ$. This systematic error, which was designated "K" by Campbell, has not yet been satisfactorily accounted for, but it is such as would arise if, in the helium stars, the lines were subject to a pressure effect which caused them to be displaced slightly to the red side of their normal positions; the effect of such a displacement would clearly be to superpose on the real radial motions a receding velocity of about 4 km. for all the stars, irrespective of their positions on the celestial sphere. The magnitude of K, and the sun's velocity, are determined on the supposition that, in the mean, the stars are at rest with respect to the stellar system.

Forming the helium stars on the ascending branch of Lockyer's series into one group, and those of the descending branch into another, Dr. Herassimovitch proceeds in the usual way to determine the sun's velocity and the K term for each group, using equations of the form

$$V_0 \cos \phi + K = V,$$

where V_0 is the velocity of the sun, ϕ the angular distance of the star from the apex of the sun's way, V the observed radial velocity reduced to the sun by correction for the earth's orbital motion, and K the residual velocity. In each group, K is thus the mean algebraic residual after eliminating the solar motion. The results are as follows:—

$$\text{From 57 stars on the ascending branch} \left\{ \begin{array}{l} K = +\ 6{\cdot}32 \text{ km.} \pm 1{\cdot}50 \text{ km.} \\ V_0 = -20{\cdot}84 \text{ km.} \pm 2{\cdot}40 \text{ km.} \end{array} \right.$$

$$\text{rom 47 stars on the descending branch} \left\{ \begin{array}{l} K = +\ 1{\cdot}17 \text{ km.} \pm 1{\cdot}136 \text{ km.} \\ V_0 = -20{\cdot}03 \text{ km.} \pm 2{\cdot}29 \text{ km.} \end{array} \right.$$

Thus, while the resulting velocity of the sun is almost the same for the two groups, the values of K are strikingly different. For the descending branch, in fact, K almost disappears, while for the ascending branch its value is considerably in excess of that found by Campbell from all the helium stars taken together. Lockyer's differentiation of the ascending and descending branches thus receives substantial corroboration.

It was already known from the work of Campbell that the groups of stars giving the largest values of K (*i.e.* the Harvard classes B, K, and M [1]) are among the most distant, and Dr. Herassimovitch has therefore further discussed the ascending and descending groups in relation to the mean parallaxes. Applying Kapteyn's formulæ, it results that for the helium stars on the ascending branch the probable mean parallax is $0{\cdot}005'' \pm 0{\cdot}0009''$, and for the descending branch $0{\cdot}012'' \pm 0{\cdot}0030''$. By the same process, Campbell has found for the Harvard classes B0–B5 a mean parallax of $0{\cdot}006''$, and for the classes B8–B9 a mean parallax of $0{\cdot}0129''$, which are nearly identical with the values now found for the ascending and descending stars. A predominance of B0–B5 stars on the ascending branch, and of B8–B9 stars on the descending branch, would thus account for the observed difference in the mean parallaxes. But this cannot account for the whole difference, for although there are actually a greater number of B8–B9 stars on the descending than on the ascending branch of Lockyer's curve, the excess among the stars here considered is only four. It would seem, then, as in the general case, that the more distant group of helium stars gives the larger value of the K term, and it is interesting to find that Lockyer's criteria for spectroscopic classification have so successfully withstood this further test.

Dr. Herassimovitch has also investigated the ascending and descending groups in relation to the magnitudes of the stars involved. Omitting those at the summit of the curve, there are 155 helium stars available for this part of the inquiry, and the figures show that the stars on the descending branch are in general fainter than those on the ascending branch. This difference cannot be explained entirely by the excess of classes B8–B9 on the descending branch, because within the limits of a given Harvard sub-group, say B3–B5, there is the same increase in the number of faint stars on the descending branch as when all the B stars are taken together. When correction is made to absolute magnitudes, by applying the mean parallaxes previously deduced, it also appears that the stars of the descending branch are in general fainter than those of the ascending branch which fall in the same Harvard sub-class, and are therefore presumably at the same stage of temperature.

Stars at the same heat level on opposite sides of the temperature curve probably have the same intrinsic brightness, and if it be assumed that the average masses are equal, it would follow that the stars on the ascending branch must in general be of greater volume and lower density than those on the descending branch. This is precisely the physical difference which is demanded by Lockyer's hypothesis, and also by that of Russell, and it may reasonably be supposed capable of explaining the spectroscopic differences which have enabled Lockyer to sort out the two classes.

The nature of the K term remains obscure. If the greater brightness of the stars of the ascending group, which gives a large value of K, could be attributed to greater mass, and not merely to greater volume, it might be possible to regard K as a function of the mass. The effect of great mass might then be to produce the pressure displacement mentioned by Campbell as a possible explanation. Or, as Dr. Herassimovitch points out, a displacement of the stellar lines to the red, such as would account for the K term, might possibly result from the gravitational field in the case of great masses, in accordance with Freundlich's deduction from the theory of relativity. There appear to be some difficulties, however, in connection with the latter hypothesis, and it may be added that the Mount Wilson observers have been unable to detect any systematic effect of this kind in the case of the sun, although the calculated effect is considerably greater than the errors of observation (Mt. Wilson Report, 1914, p. 255). On either supposition, however, it seems improbable that there would be so great a difference in masses for Lockyer's two groups of helium stars as to account for the large value of K in the ascending group and its practical disappearance in the descending group.

---

[1] K is practically zero for stars of classes A, F, and G.

It at least seems clear, from the above results, that K can no longer be regarded as a constant error, having a fairly definite value for each of the Harvard classes. Prof. Perrine has also recently been led to this conclusion (*Astrophys. Journ.*, November, 1916), and is inclined to the opinion that the observed residuals represent velocity displacements. Whatever the true explanation may be, Dr. Herassimovitch's investigation emphasises the importance of taking account of Lockyer's criteria in the classification of stars of the helium group. A. FOWLER.

THE POTATO SUPPLY.

THE average potato crop of Great Britain is a little over 2 million tons, and that of Ireland a little under this figure. Great Britain and Ireland together contribute rather less than 5 per cent. of the world's crop of 91½ million tons. In normal years the British Isles grow nearly, or quite, enough potatoes to satisfy home needs. Accessory supplies are, however, derived from the Channel Islands, Normandy, Brittany, and other sources.

Hence it might be doubted whether even in these exceptional times there is need for any large measure of forethought or room for much anxiety with respect to our potato supplies.

A combination of circumstances, however, has co-operated to make this year's potato crop a matter of considerable national importance.

First among these circumstances is the fact that very large quantities of potatoes are required for his Majesty's forces. Moreover, there is reason to believe that the French have been large purchasers. Secondly, last year's potato crop was below the average, both in Scotland and in certain parts of England. In some districts the crop, though fair in amount, proved to be badly diseased at lifting time; a sure indication of loss in store. Exact information as to the total yield in this country is not available, but it may be taken as probable that it does not amount to two-thirds of the average crop.

The reasons for the shortage are numerous, but one of the chief is undoubtedly the adverse season of 1916; lack of labour for hoeing, absence of supplies of potash manures, and the high price of other artificial manures also contributed to the misfortune.

In consequence of the partial failure of the crop it was foreseen that prices would rise to a high level, and it was hoped that official action would be taken while the bulk of the crop was in the ground, and before contracts were entered into. The hope was not realised. Warnings were ignored—for to warn before it is too late is to be premature. More serious than the rise in price of ware (food potatoes) was the rise in the price of seed. Scotch seed, which, together with Irish, gives a higher yield than English seed, was known to be scarce, and thrifty men, in order to secure seed betimes, paid so much as 25*l.* to 30*l.* per ton for seed of good varieties.

At this stage prices were fixed—maximum price for last year's crop, maximum for the crop not yet sown, and for the seed for sowing. The price fixed for next year's crop had the immediate effect of determining everyone whose patriotism was not very much deeper than his pocket to abandon the idea of growing potatoes, for they knew that a maximum price of 115*s.*–130*s.* per ton would mean growing the crop at a loss. Plain men were puzzled to know why a beleaguered city must at all costs save itself from a glut of potatoes. There was an outcry, and the maximum price for next year's crop became a minimum.

With respect to seed the fixed prices remain: 12*l.* per ton as a maximum, and at the present moment anyone who wants to grow potatoes can, as we are assured by the Board of Agriculture, buy the *best seed* from the Board at 12*l.*, or from any of the leading seedsmen at double the price. If the article supplied by the Board proves indeed to be the best with respect to origin, size, and trueness to name, purchasers who waited on providence will have reason to laugh at their more provident brother-growers who bought betimes. The authorities have gone one better than the parable: the late-come labourers get twopence instead of the penny earned by those who bore the heat and burden of the day. Nevertheless no public-spirited person will grumble if he can be assured that the Board has dealt justly with the grower of the seed, and is able to supply seed tubers *of the best quality* at 12*l.* per ton. Rather will he incline to a belief in miracles. The view is commonly held that there will be too many potatoes grown this year. Facts, however, do not warrant that view. There is a general shortage of corn crops, transport is disorganised, farm lands lack expert labour, artificial manures are dear and scarce, and seed is likely to be of